

Art + Science Series

Photography 1: How Does a Camera Work?

Grades 5-8

This packet includes:

PROGRAM OBJECTIVES:	2
NATIONAL EDUCATION STANDARDS:	2
SUPPLIES NEEDED FOR VIDEOCONFERENCE:	3
IMPORTANT SAFETY NOTE:	3
PRIOR TO THE PROGRAM:	4
VOCABULARY:	4
TEACHING EXTENSIONS:	5
IDEAS FOR RESEARCH PROJECTS:	7
ADDITIONAL RESOURCES:	7
DISPOSABLE CAMERA FRONT LABELED PHOTOGRAPH	9
DISPOSABLE CAMERA BACK LABELED PHOTOGRAPH	10
<i>HOW DOES A CAMERA WORK?</i> CAMERA DISSECTION ACTIVITY SHEET	11
<i>HOW DOES IT WORK?</i> POST-LESSON STUDENT REVIEW SHEET	12

Teacher note:

In order to participate in this interactive program, please bring all the supplies listed in the teaching information packet to your videoconferencing site, along with photocopies of the ***How Does a Camera Work? Dissection Activity Sheet*** for every student.

Art + Science Series

Photography 1: How Does a Camera Work?

Grades 5-8

Program Objectives:

- Students will learn that a non-digital camera consists of three basic parts: an optical component (lens), a mechanical component (camera body) and a chemical component (film).
- Students will identify the interior and exterior elements through dissection of a disposable 35mm camera and learn the function of the lens, aperture, shutter, shutter release and viewfinder.
- Students will learn how to handle and operate a camera safely.

National Education Standards:

For Visual Arts Education (grades 5-8):

- Understanding and applying media, techniques, and processes.
- Understanding the visual arts in relation to history and cultures.
- Making connections between visual arts and other disciplines.

For Science (grades 5-8):

- Science as inquiry
- Physical science
- Science and technology
- History and nature of science

Since its introduction to the public in 1839, photography has drastically altered both the way we perceive the world and how we communicate with each other. The camera has also changed drastically; yet at the same time, hardly at all. While it has changed in format from a large wooden box with simple lenses to sleek models that fit in the palm and export images directly to personal computers, it still shares three main elements with its earlier ancestors: a lightproof container, an optical element, and an image-capturing device. In the first of a two-part program exploring the science and art of photography, students will discover the inner workings of a

simple disposable camera and lay the foundation for the discovery of their own creative view through the camera.

Supplies needed for videoconference:

For each student group –

1. used disposable cameras, preferably all Kodak brand (but not Kodak Power Flash)
(Retail film processors may have used disposable cameras available at no charge. Allow time prior to your lesson to accumulate enough camera bodies for each student; plan to have 1/3 more than you actually need).
2. eyeglass screwdriver -OR- orange stick (for manicures) -OR- popsicle stick
3. dissection or cafeteria tray

For each student –

4. rubber or latex gloves
5. safety goggles
6. *How Does the Camera Work?* Activity Sheet for diagramming front and back of camera.
7. pencil and eraser

Teacher -

8. rubber handled screwdriver
9. thick rubber gloves
10. 2' x 2' square of heavy gauge aluminum foil (or give each group their own piece of foil)

Important Safety Note:

Like most electronic devices, the disposable camera can be a source for hazardous electric shock. Flash circuit voltage may be as high as 300V when fully charged, and can store up to 50V even after the battery has been removed. Prior to the program, instruct students not to touch the interior circuit board or battery connectors with their hands. If using flash cameras for dissection, the teacher must remove the AA battery from the camera. During the program, we will demonstrate how to short out the circuit board by rubbing it with the square of metal foil, before allowing the students to handle the exposed camera interior. **Do not touch the circuit board with anything other than rubber-gloved hands or a rubber-handled screwdriver when discharging the camera.** If you do not want the students to discharge their own cameras, you may do this part beforehand. **However, the students should still be wearing rubber or latex gloves during the dissection.** The presenter for your lesson will explain this activity during the video conference, but please feel free to contact us, if you have any concerns.

Prior to the Program:

- Divide class into groups of two or three for camera dissection.
- Distribute supplies needed for the videoconference.
- Discuss safety guidelines.

You may want to ask students if they can describe what a camera is and what it does. Many different styles of cameras are used to take photographs. While this lesson focuses on film (or chemical-based) imaging, cameras which use digital imaging are becoming increasingly common. Encourage student exploration of the difference between these two types of technology.

Vocabulary:

Aperture – a circular opening that controls the amount of light entering the camera.

Camera – a machine that uses a lens or small opening to record light on a sensitized material.

Camera Obscura – “dark room” (Latin) where light enters through a small hole in a wall and forms an upside-down image of the outside scene on the opposite inside wall.

Depth of Field – the area of a picture that is in focus.

Electronic Flash - additional light source that provides brief, intense, white light.

Exposure - the amount of light striking the film when a photograph is taken.

Film - a thin, transparent material with a light sensitive coating that records light entering the camera.

ISO - a system of numbers which indicates the sensitivity of film to light. Also known as ASA.

Lens - a curved piece of glass or plastic that can bend light. Used in a camera to focus light on film. From the Latin word for “lens.”

Negative - an image produced on film that has the light and dark or color areas reversed.

Photography – from the Greek word *photos* or “light” and *graphia* or “write.”

Positive - an image produced on film that reproduces the light and dark or color areas exactly as seen.

Refraction – bending or turning of light rays when traveling obliquely from one medium into another.

Shutter release - the button on a camera that triggers the operation of the shutter and flash.

Shutter speed - indicator of the length of time the shutter stays open.

35mm - a size or format of photographic film.

Viewfinder - a clear window on a camera used for seeing the subject area.

Teaching Extensions:

1. *Investigating the property of light through the camera obscura (science)*

Explanation: We can probably thank the phenomena of the solar eclipse for the invention of the camera. In the ancient world, the Greek philosopher Aristotle (384-322 BC) described a safe method of viewing the eclipse by using a hole punched in metal to create a projected image of the sun. Arabian scholar Alhazen, c. 965 – 1039, also used a pinhole in his experiments with light, proving his theory that light reflects off objects and does not emanate from the eye like Superman's x-ray vision. This pinhole principle known as the *camera obscura* became popular during the Renaissance, when Italian artists and draftsmen used it as a drawing aid to accurately depict perspective.

The early camera obscura was typically a completely dark room large enough for a person to walk into, with a small hole on one wall to allow light to pass through and form an upside down, reversed image of the outside scene on the opposite wall. The addition of a lens and diaphragm in the 1500s aided in sharpening the image, while the room's size shrank to the form of a folding tent or box which could be carried from location to location.

Research: *Artists and scientists to investigate include Aristotle, Alhazen, Leonardo da Vinci, Canaletto, and Vermeer. Pick one or more of these individuals and briefly summarize their thoughts or involvement with the properties of light. Then try one of the projects below.*

Project:

Make a room-sized camera obscura

Required materials: room with a window, sunshine, black plastic sheeting, and masking tape. Cover windows, doors, or anything that allows light into room with black plastic and turn off all lights so the room is completely dark. Make a small hole in the black plastic that covers one window. Experiment with holding a sheet of white paper parallel to, and at various distances from the pinhole to determine your focal plane.

Make a portable camera obscura

Excellent instructions for making a portable camera obscura out of a Pringles™ potato chip can on the web: www.exploratorium.edu/science_explorer/pringles_pinhole.html

2. *Exploring the relationship between intensity of light and exposure time (science)*

Explanation: Both photographic film and paper are sensitive to light because of their coating with a gelatin-based emulsion of silver halide crystals. Light striking the emulsion causes an invisible chemical change—or latent image—to form on the surface. The film or paper is then bathed in a chemical or developer that changes the silver halide crystals exposed to light into silver metal, or shades of gray and black. The crystals not exposed to light remain unchanged, to be washed away by another chemical, or fixer.

On black and white negative film, areas that received the most light—such as the sky—are dark, or the reverse of their actual appearance. When light is projected through the negative onto

the photographic paper, the dark areas block the light falling onto the paper, leaving those areas light as in their actual appearance.

The cyanotype (or Sunprint™ paper) offers an introductory printing experience for the elementary classroom because it uses the same negative image principle as silver-based photographic paper, yet only UV or sunlight and water are required for the development and fixing process

Developed by scientist Sir John Herschel in 1842, the cyanotype produced a distinctive blue image due to a light-sensitizing coating of ferric ammonium citrate and potassium ferricyanide. While the process was simple to use, most 19th century photographers did not admire the blue image. It's most common use has been for the reproduction of engineering drawings, or blueprints.

The cyanotype is a printing out process, which means the image appears as it is exposed to light. Students will be able to see the chemical change and gauge the length of time necessary for an image to develop. After enough exposure, the paper is washed in water to remove the soluble unexposed salts. Upon drying, the image darkens as a result of slow oxidation in air. Treatment with an oxidant such as hydrogen peroxide will create a darker blue image.

Research: *Artists and scientists to investigate include Sir John Herschel, Anna Atkins, Edward S. Curtis, Betty Hahn, and Robert Rauschenberg. Have students find information on, or a cyanotype image by one of these individuals. Share the information or images with the class as a prelude to the projects listed below.*

Project:

Experiment with cyanotype paper

Required materials: Sunprint paper, acrylic sheet, cardboard, a tub full of water, interesting objects to print, sunlight. Complete online instructions, as well as illustrations: <http://www.sunprints.org/how-it-works/>

Sunprint paper is used for contact printing, so students will place objects directly on the paper to produce a negative image. Encourage experimentation with objects of various shapes and opacities. Students can make their own “film” negative by drawing on acetate sheets with black markers, photocopying images onto copier-compatible acetate sheets, or cutting out paper shapes (such as a silhouette) to place directly on the sunprint material.

Pre-coated cyanotype (Sunprint) paper suppliers:

- *Sunprint, Lawrence Hall of Science, University of California, Berkeley*
<http://www.sunprints.org/products/>
- *Freestyle Photographic Supplies:*
http://www.freestylephoto.biz/sc_main.php?cat_id=104
- *Science Kit and Boreal Laboratories*
<http://sciencekit.com/sunprint-kit/p/IG0027747/>

Ideas for research projects:

1. *Explain how the technology of photography influences the quality of our life.*

How do most of us know what Michael Jordan looks like, or the surface of Mars? How are missing children located?

2. *Examine how science and technology have advanced through the contribution of many different people, cultures, and times in history.*

Additional Resources:

Books for Students:

Haslam, Andrew. *Make It Work! Photography*. Chicago: World Book Inc. 1996.

Macaulay, David. *The New Way Things Work*. Houghton Mifflin Co. 1998.

Oxlade, Chris and Morrison, Alex. *Investigations: Cameras*. Lorenz Books. 2000.

Wallace, Joseph. *The Camera*. New York: Athaneum Books for Young Readers. 2000.

Books for Teachers:

Adams, Ansel with Baker, Robert. *The Camera*. Boston: Little Brown & Co. 2003. 1980.

Hedgecoe, John. *The Photographer's Handbook*. New York: Knopf. 1992.

Shull, Jim. *The Beginner's Guide to Pinhole Photography*. Buffalo: Amherst Media. 1999.

The Camera, by the editors of Time-Life Books. Alexandria: Time-Life Books. 1970, 1981.

Websites:

Eastman Kodak. www.kodak.com

Comprehensive website provides information on cameras and film, as well as sections on "Taking Great Photos", extensive lesson plan section and biography of George Eastman (access through "search" feature).

The Exploratorium: A Museum of Science, Art and Human Perception.

http://www.exploratorium.edu/light_walk/lw_main.html

Artist Bob Miller explores the nuances of light, shadow and images in an online "Light Walk." Includes activities to do in and out of the classroom.

How Stuff Works. <http://www.howstuffworks.com/camera.htm>

Easy to understand sections on how cameras work and how photographic film works.

Timeline of Photographic History.

<http://www.eastmanhouse.org/inc/collections/photography.php>

Key events in the history of the photographic arts in an interactive timeline from the George Eastman House

“Was it Done with Mirrors?”

<http://www.cbsnews.com/stories/2003/01/16/60minutes/main536814.shtml>

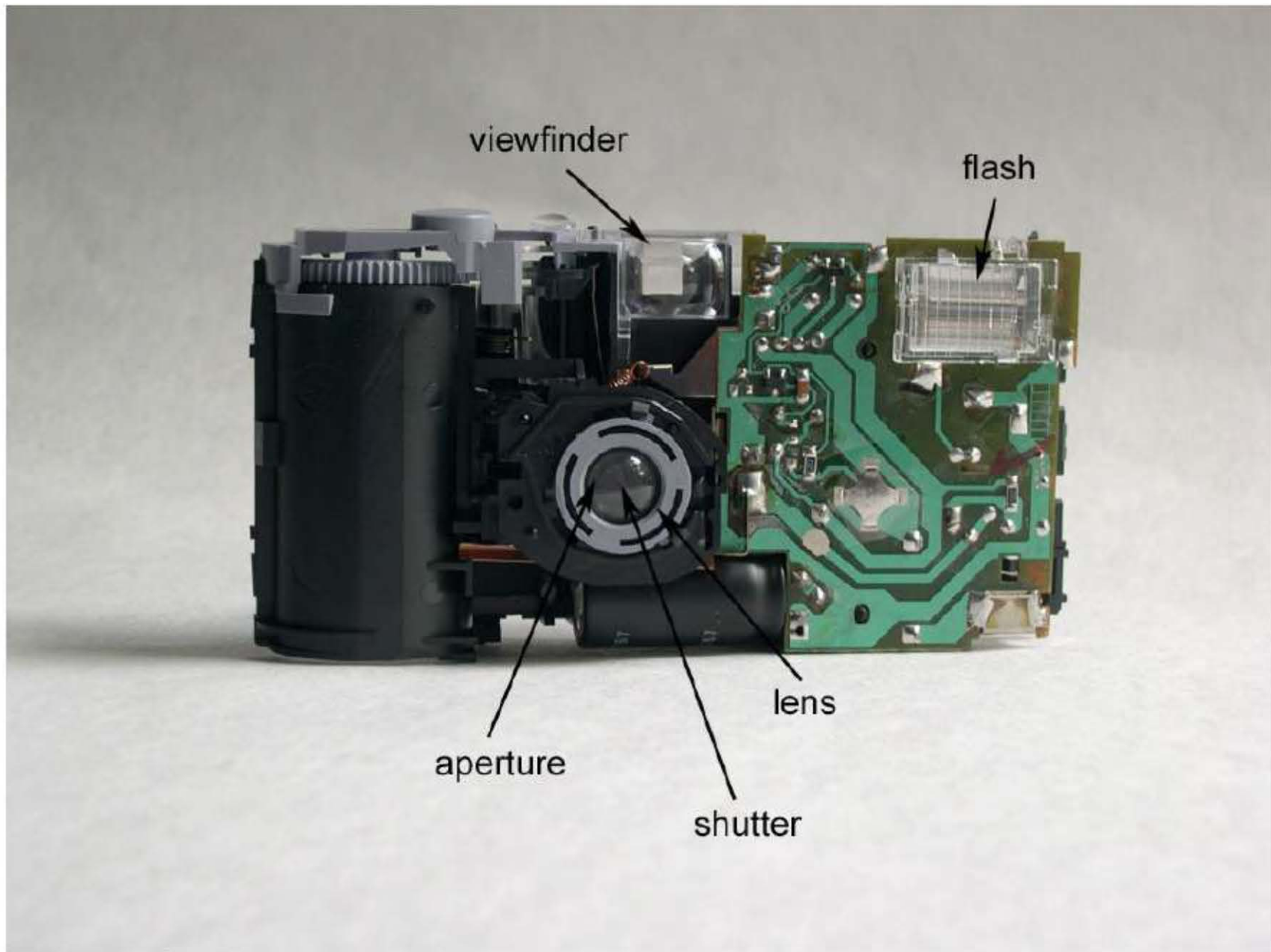
CBS 60 Minutes news article about painter David Hockney’s controversial theory concerning the old masters of the Renaissance and the science of optics.

Worldwide pinhole photography day. <http://www.pinholeday.org/gallery/index.php>

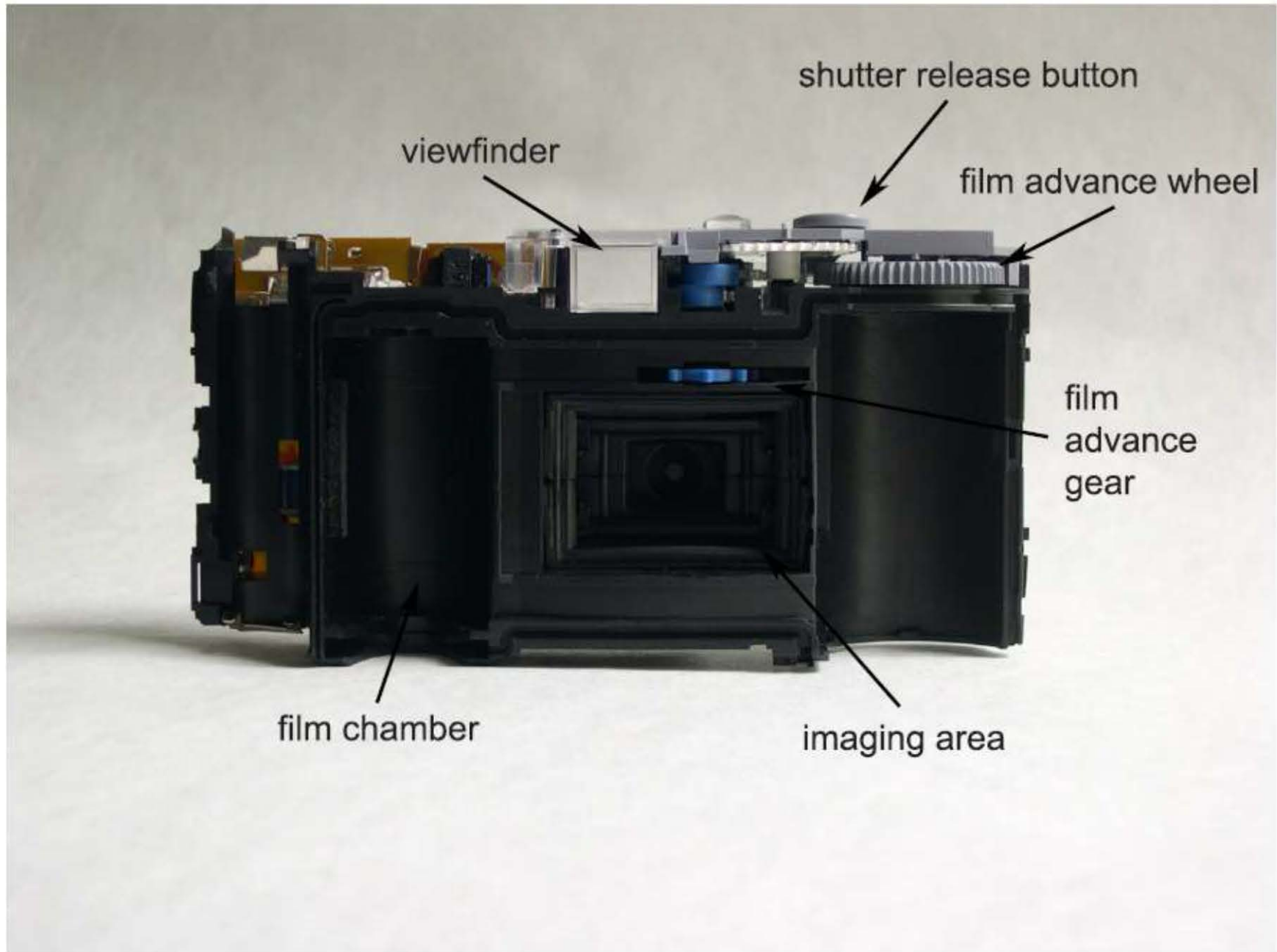
Online exhibit of images taken on April 23, 2003 by people with pinhole cameras around the world.

This lesson was co-written by Colette Buck and Jennifer Vincenty, Lorain Middle School, Lorain, Ohio.

Disposable Camera Front Labeled Photograph



Disposable Camera Back Labeled Photograph



How does a Camera Work?

Disposable Camera Dissection Activity Sheet

Draw the front view of your dissected camera and label the following parts:

lens

viewfinder

flash (if your camera has one!)

aperture

shutter



Now draw the rear view of your dissected camera and label the following parts:

viewfinder

Imaging area

shutter release button

film advance gear

film advance wheel

film chamber



Bonus points! Draw and label the circuit board and flash capacitor on the camera

Disposable Camera Dissection: interior review sheet

Label the following parts and describe their function:

viewfinder

lens

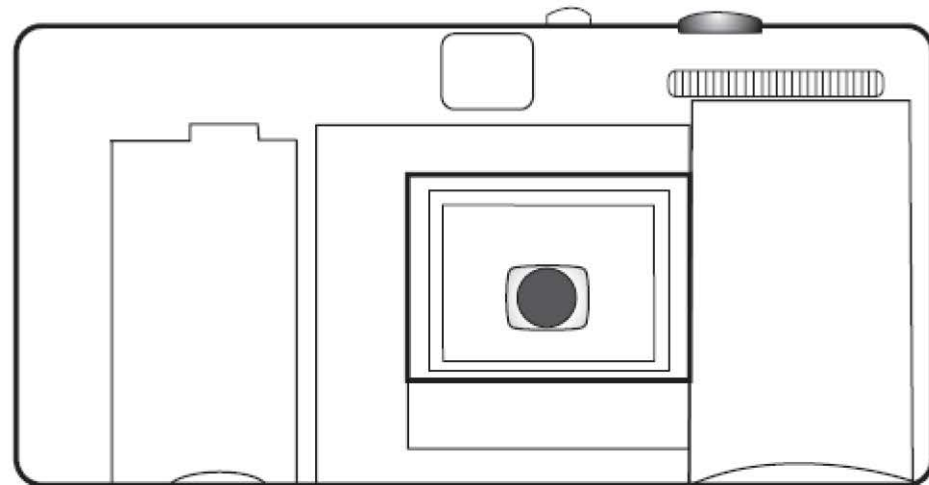
shutter

shutter button

film advance wheel

film (or focal) plane

08/02/12



How does it work?